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A LINEAR PROGRAM FOR TRANSPORTATION COST MINIMIZATION OF BCT-AI--ETC(U)
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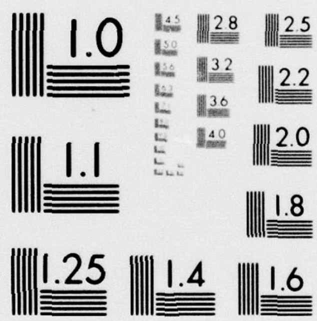

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9 Research ~~Memorandum~~ 63-7

6 A LINEAR PROGRAM FOR TRANSPORTATION COST MINIMIZATION OF BCT-AIT SHIPPING.

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A LINEAR PROGRAM FOR TRANSPORTATION COST MINIMIZATION OF BCT-AIT SHIPPING

BACKGROUND

The Combat Allocation Task was initiated by USAPRO in 1957 in response to USCONARC's concern that an insufficient supply of able personnel was reaching combat units. The objective was to provide a system of assigning enlisted men to advanced training resulting in an adequate and equitable distribution of available aptitudes among combat units, combat support units, and other branches of the Army. The system chosen must provide optimal allocation of personnel to MOS based on Army manpower requirements and personnel qualifications. In anticipation of Army needs, USAPRO personnel recognized that an optimal system for allocating personnel would require the use of stored-program computing equipment. During FY 1961 and FY 1962, the Combat Allocation Task began the development, elaboration, and testing of a computer-based assignment method for allocation of uncommitted enlisted personnel to MOS training.

In September, 1962, the Adjutant General's Office formulated plans for an Automatic Data Processing System (ADP) for handling the flow of trainees through the training base. Under this system, processing is divided into four phases, or ACT's (Automated Control of Trainees). ACT I is concerned with initial input and control of a master file. ACT II treats the distribution of basic combat training (BCT) personnel to advanced individual training (AIT) and/or directly to unit assignment, while ACT III handles the assignment from AIT to the unit. ACT IV is the statistical analysis program for the total ADP system package. Under this proposed ADP system, Army personnel processing activities were unified under TAG control.

As an outgrowth of this unification, a joint TAG-USAPRO effort was initiated and directed primarily toward the development of automated procedures for providing trainees in BCT with their next assignment (ACT II). USAPRO expanded its earlier effort to include the development and testing of a computer program (Transportation Program) for the minimization of costs related to transportation of allocated personnel from BCT to AIT for their respective MOS training. This new effort was in addition to the continued testing of the previously developed computer program for the optimal allocation of uncommitted trainees. The Transportation Program for shipping cost minimization includes as input both the assignments to MOS of uncommitted enlisted personnel as allocated by the optimal allocation program and the assignments of committed, earmarked, and special category enlisted personnel as determined by TAG-designed methods. The present Research Memorandum describes the development of the Transportation Program.

THE TRANSPORTATION PROBLEM

The problem of transportation costs arises when BCT trainees at more than one center are assigned to advanced training in an MOS which is offered at more than one location. The cost of travel from BCT to AIT is determined by the mileage between the two locations. Clearly, certain routes are preferable to certain others on a sheer dollar/mile basis. However, the number of trainees who can make a preferred trip is limited by the number of trainees at a given BCT center and the capacity of the advanced training location. The optimum solution to this problem is to ship all trainees from BCT to AIT in such a way that the total cost of the transportation is at a minimum.

Problems of the kind mentioned above are formally stated as follows:

Let c_{ij} be the unit cost of shipping a commodity from location i to destination j.

x_{ij} be the number of units of the commodity to be shipped from location i to destination j.

$z = \sum_i \sum_j x_{ij} c_{ij}$ be the total cost of shipping incurred for a given set of x_{ij}.

P_i be the amount to be shipped from location i.

Q_j be the amount needed at destination j.

(The problem has the restraint for solution that $\sum_i P_i = \sum_j Q_j$.)

Then, minimize the value of z subject to the linear restraints:

$$\sum_j x_{ij} = P_i$$

$$\sum_i x_{ij} = Q_j$$

$$x_{ij} \geq 0$$

Various solutions to the problem stated above, known as the Transportation Problem, have been available. Although the arithmetic required is long and tedious, only a mechanical repetition of a sequence of

precisely defined steps is involved. The time required can be reduced to minutes by the use of high speed computers where each operation is performed in micro-seconds and the complete sequence is automatic.

The first step in the solution of the transportation problem is to develop a feasible solution, one which satisfies the movement requirements. The traditional technique involves a routine of iterations through a succession of feasible solutions of gradually diminishing cost to a feasible solution of minimal cost (the optimal solution). This procedure is lengthy and inefficient for computer operation. Therefore, a newer method--the Hungarian Method--was adopted.1/

In using the Hungarian Method for solution of the transportation problem, one begins with an initial optimal, albeit infeasible, solution to the problem (in contrast to the traditional technique mentioned above) and iterates through other optimal solutions until some feasible solution is reached. A feasible solution means a set of individual allocations such that all restraints are satisfied, that is, existing surpluses are removed and existing deficiencies are filled.

GENERALIZED COMPUTER PROGRAM

The program, while developed to minimize transportation costs for BCT-AIT shipping, is adaptable to related problems. The general format of the program will accommodate four (4) character cell entries with the initial COST2/ matrix (c_{ij} matrix), the final transportation matrix (x_{ij} matrix)--called SEND--and the ROW (P_i) and COL (column) (Q_j) restraints. The row and column entries, therefore, may not exceed a value of 9,999. An additional restriction is placed on the maximum entries for the cost matrix. Due to the arithmetic operations of the computer and the numerical aids required for programming facilitation, no entry in the cost matrix may exceed a value of 3,499. As an alternate restriction, the sum of the two largest entries combined may not exceed a total value of 6,999. Either of these two parameter limitations must be observed unless special conditions pertain to the specific problem.

1/ The basic steps of this solution were obtained during attendance by USAPRO personnel at the University of Michigan's Summer Conferences on System Engineering, 1961. This method is presented in Appendix A.

2/ The use of capital letters here refers to actual abbreviations and mnemonic symbols used in the program.

VARIABLES REQUIRING DEFINITION

To operate within the framework of the program, certain variables require specific definition for each individual problem:

Variables	Size
SEND	Number of cell entries x 4
COST	Number of cell entries x 4
COL	Number of columns x 4
ROW	Number of rows x 4
M	Number of rows
N	Number of columns
FOURM	Number of rows x 4
MN	Number of rows x number of columns

The term SEND refers to the computer area set aside for compilation of the final transportation matrix, which contains the solution to the problem. Each cell entry yields the number of units to be shipped to the destination specified by the column from the origin specified by the row. COST refers to the area set aside for the initial input to the cost matrix (the cell entries). Each entry is the cost, or scaled cost, of shipping one unit from a given origin to a given destination. COL is the area set aside for input of the capacity quotas at each destination. This value determines the number to be shipped to this destination. ROW is the area set aside for input of the units available for transport at each origin. The other terms must be specified for each specific problem.

COMPUTER PROGRAM FOR BCT-AIT TRANSPORTATION

Given appropriate ROW, COL, and COST inputs, the program results in a solution such that the distribution of numbers of trainees from multiple BCT centers to multiple AIT locations is accomplished with the total cost of the necessary differential transportation at a minimum. In minimizing the cost, both the manpower available at the BCT centers and the quotas for training at the AIT locations are taken into account. Because only 13 percent of the AIT courses have multiple locations, this program operates efficiently, treating each multiple destination MOS separately.

The major restriction is that the total available personnel, the sum of the row values, must equal the total assignment quotas at the destinations, that is, the sum of the column values ($\sum_i P_i = \sum_j Q_j$). Any discrepancy between these two sums will result in an invalid solution if any solution is obtained.

PROGRAM SYMBOLOGY

The first step in the design of the actual program was to chart the flow of the Hungarian Method in computer language. This crucial initial effort was accomplished by Dr. Marjorie O. Chandler of the USAPRO research staff, who utilized FORTRAN symbology for this chart. When FORTRAN was found to be inefficient for use with the IBM 1401 system, the logical FORTRAN operations were translated into AUTOCODER (a symbology more compatible with 1401 systems), and the program was written in this symbolic language. AUTOCODER, one of two basic symbolic programming aids for the 1401 Data Processing Systems, consists of a set of language specifications used to write the source program. A processor program translates the symbolic language program into the actual machine language program. AUTOCODER permits the user to define areas and write instructions by writing symbolic statements. These statements are written using mnemonic operation codes and the symbolic names with which the user defines his fields.

REQUIRED DATA

The data necessary for the operation of this program are the initial cost matrix, the column values, and the row values. These are punched on standard IBM punch cards, using four columns for each entry. All 80 columns may be used if necessary. The first card is for the cost matrix.3/ If the matrix is larger than can be accommodated on one card, additional cards may be used as needed. The second card, or group of cards, specifies the column values. The third specifies the row values. These data cards should always be introduced following the object program (actual machine language program) in the order in which they have been described.

SAMPLE SOLUTION

The example used for program presentation comprises a 7 x 8 cost matrix. Computer running time for this sample problem using actual cost data was approximately 30 seconds from the time the first card of the object program was read until the solution was output on the printer. This same problem, when solved manually, required approximately two hours to reach the same solution.

The complete program is presented as Appendix B.

3/ Data must be entered onto cards by elements within columns, starting with column 1 of the matrix. The first entry comprises card columns 1-4.

REFERENCES

Churchman, C. W., Ackoff, R. L., and Arnoff, E. L. Introduction to operations research. New York: John Wiley and Sons, Inc. 1957.

IBM Reference Manual, IBM 1401 data processing system. Endicott, N. Y. 1962.

Sasieni, M., Yaspan, A., and Friedman, L. Operations research -- methods and problems. New York: John Wiley and Sons, Inc. 1959.

APPENDIX A

TRANSPORTATION PROBLEM BY THE HUNGARIAN METHOD

APPENDIX A

TRANSPORTATION PROBLEM BY THE HUNGARIAN METHOD

1. Subtract from each row its smallest element. Then subtract from each column of the resulting matrix its smallest element.

2. Pick a trial set of quotas by assigning them to zeros, subtracting appropriately from the discrepancies.

3. Cover each column whose discrepancy is zero.

4. Find an uncovered zero (if there is none, go to step 7). Prime it. Check the discrepancy of the row; if it is not zero, go to step 6. If it is zero, go to step 5.

5. Cover the row, and for each twice covered essential zero, star the zero and uncover its column. Go to step 4.

6. There now exists a unique chain, starting at the primed zero, going vertically to a starred zero, horizontally to a primed zero, etc., and ending on a primed zero (with no starred zero in the column).

   Find the smallest of the following numbers; the discrepancy of the row of the first primed zero in the chain; the discrepancy of the column of the last primed zero in the chain; the quota of each starred zero in the chain. This number is to be subtracted from each of these two discrepancies, and from the quota of every starred zero in the chain, and to be added to the quota of every primed zero in the chain. Now erase all primes and stars, uncover all rows, and, if the solution is not complete, go to step 3.

7. Find the smallest uncovered element in the matrix. Add this element to the covered rows and subtract it from the uncovered columns (or add it to the covered columns and subtract it from the uncovered rows) (or add it to the twice-covered elements and subtract if from the uncovered elements). Do not change any stars, primes, or coverings. Go to step 4.

NOTE: "Discrepancies" are amounts to be shipped which have not yet been assigned. "Quotas" are amounts which have already been assigned to particular elements of the matrix (i.e., particular routes). An essential zero is one whose quota is greater than zero.

APPENDIX B

AUTOCODER PROGRAM FOR BCT-AIT TRANSPORTATION

```
                CTL      551
        SEND    DA       56X4,X3
        COST    DA       56X4,X3
        COL     DA       8X4,X2
        ROW     DA       7X4,X1
        X1      EQU      89
        X2      EQU      94
        X3      EQU      99
        SET     DCW      0
        M       DCW      &0007
        N       DCW      &0008
        FOURM   DCW      028
        ONE     DCW      &0001
        FOUR    DCW      004
        ZERO3   DCW      000
        ZERO4   DCW      &0000
        K       DCW      &9999
        INDEX   DCW      &0000
        MIN     DCW      &0000
        W       DCW      003
        MONE    DCW      -0001
        MI      DCW      &0000
        NJ      DCW      &0000
        TS1     DCW      000
        TS2     DCW      000
        TS3     DCW      000
        TS4     DCW      &0000
        TS5     DCW      &0000
        NINT    DCW      &9000
        NINTO   DCW      &9001
        AYTT    DCW      &8000
        AYTTO   DCW      &8001
        MN      DCW      &0056
        OBJECT  MLC      MN,NJ
                CS       99
                SW       97
                SW       92
                SW       87
                SW       1
                R
                MLCWA    80,COST&79
                R
                MLCWA    80,COST&159
                R
                MLCWA    64,COST&223
                R
                MLCWA    32,COL&31
                R
                MLCWA    28,ROW&27
                MLC      ZERO3,X3
        FIRST   SW       COST&X3
                MA       FOUR,X3
                S        ONE,NJ
```

```
        C       NJ,ZERO4
        BL      FIRST
        MLC     ZERO3,X2
        MLC     N,NJ
SECOND  SW      COL&X2
        MA      FOUR,X2
        S       ONE,NJ
        C       NJ,ZERO4
        BL      SECOND
        MLC     ZERO3,X1
        MLC     M,MI
THIRD   SW      ROW&X1
        MA      FOUR,X1
        S       ONE,MI
        C       MI,ZERO4
        BL      THIRD
        H
        MLC     W,X1
        MLC     W,X2
        MLC     W,X3
        MLC     N,NJ
AA      MLC     M,MI
AB      C       ZERO4,COST&X3
        MLC     ZERO4,SEND&X3
        BU      AD
        C       ROW&X1,COL&X2
        BL      AC
        MLC     ROW&X1,SEND&X3
        S       ROW&X1,COL&X2
        MLC     ZERO4,ROW&X1
        B       AD
AC      MLC     COL&X2,SEND&X3
        S       COL&X2,ROW&X1
        MLC     ZERO4,COL&X2
AD      MA      FOUR,X1
        MA      FOUR,X3
        S       ONE,MI
        C       MI,ZERO4
        BL      AB
        MA      FOUR,X2
        MLC     W,X1
        S       ONE,NJ
        C       NJ,ZERO4
        BL      AA
AE      MLC     W,X2
        MLC     N,NJ
AF      C       ZERO4,COL&X2
        BU      AG
        MLC     MONE,COL&X2
AG      MA      FOUR,X2
        S       ONE,NJ
        C       NJ,ZERO4
        BL      AF
```

```
AH     MLC    W,X1
       MLC    W,X2
       MLC    W,X3
       MLC    N,NJ
       MLC    M,MI
AJ     BWZ    AM,COL&X2,K
AK     C      ZERO4,COST&X3
       BU     AL
       BWZ    AL,ROW&X1,K
       B      AP
AL     MA     FOUR,X1
       MA     FOUR,X3
       S      ONE,MI
       C      MI,ZERO4
       BL     AK
       MLC    W,X1
       MLC    M,MI
       MA     FOUR,X2
       B      AN
AM     MA     FOUR,X2
       MA     FOURM,X3
AN     S      ONE,NJ
       C      NJ,ZERO4
       BL     AJ
       C      ZERO4,INDEX
       BE     CA
       MLC    ZERO4,INDEX
       B      AH
AP     A      NINT,COST&X3
       MLC    X1,TS1
       MLC    X2,TS2
       MLC    X3,TS3
       MLC    MI,TS4
       MLC    NJ,TS5
       BWZ    APP,ROW&X1,K
       C      ZERO4,ROW&X1
       BH     BA
APP    MLC    MONE,ROW&X1
       MLC    X1,X3
       MLC    W,X2
       MLC    N,NJ
AQ     C      ZERO4,SEND&X3
       BE     AR
       BWZ    AQQ,COL&X2,K
       B      AR
AQQ    A      AYTT,COST&X3
       MLC    ZERO4,COL&X2
       MLC    ONE,INDEX
AR     MA     FOUR,X2
       MA     FOURM,X3
       S      ONE,NJ
       C      NJ,ZERO4
       BL     AQ
```

```
159            MLC    TS1,X1
160            MLC    TS2,X2
161            MLC    TS3,X3
162            MLC    TS4,MI
163            MLC    TS5,NJ
164            B      AL
165   BA       MLC    ROW&X1,MIN
166   BB       BWZ    BBB,COL&X2,K
167            C      ZERO4,COL&X2
168            BH     BG
169   BBB      S      W,X1
170            MN     X1,SET
171            MLC    SET,X1
172            S      X1,X3
173            MN     X3,SET
174            MLC    SET,X3
175            MLC    W,X1
176            MLC    M,MI
177   BC       S      AYTT,COST&X3
178            C      ZERO4,COST&X3
179            A      AYTTO,COST&X3
180            S      ONE,COST&X3
181            BE     BD
182            MA     FOUR,X1
183            MA     FOUR,X3
184            S      ONE,MI
185            B      BC
186   BD       C      SEND&X3,MIN
187            BL     BE
188            MLC    SEND&X3,MIN
189   BE       MLC    X1,X3
190            MLC    W,X2
191            MLC    N,NJ
192   BF       S      NINT,COST&X3
193            C      ZERO4,COST&X3
194            A      NINTO,COST&X3
195            S      ONE,COST&X3
196            BE     BB
197            MA     FOUR,X2
198            MA     FOURM,X3
199            S      ONE,NJ
200            B      BF
201   BG       C      COL&X2,MIN
202            BL     BH
203            MLC    COL&X2,MIN
204   BH       MLC    TS1,X1
205            MLC    TS2,X2
206            MLC    TS3,X3
207            MLC    TS4,MI
208            MLC    TS5,NJ
209            S      MIN,ROW&X1
210   BJ       A      MIN,SEND&X3
211            BWZ    BJJ,COL&X2,K
```

```
        C      ZERO4,COL&X2
        BH     BN
BJJ     S      W,X1
        MN     X1,SET
        MLC    SET,X1
        S      X1,X3
        MN     X3,SET
        MLC    SET,X3
        MLC    W,X1
        MLC    M,MI
BK      S      AYTT,COST&X3
        C      ZERO4,COST&X3
        A      AYTTO,COST&X3
        S      ONE,COST&X3
        BE     BL
        MA     FOUR,X1
        MA     FOUR,X3
        S      ONE,MI
        B      BK
BL      S      MIN,SEND&X3
        MLC    X1,X3
        MLC    W,X2
        MLC    N,NJ
BM      S      NINT,COST&X3
        C      ZERO4,COST&X3
        A      NINTO,COST&X3
        S      ONE,COST&X3
        BE     BJ
        MA     FOUR,X2
        MA     FOURM,X3
        S      ONE,NJ
        B      BM
BN      S      MIN,COL&X2
        MLC    W,X1
        MLC    W,X2
        MLC    W,X3
        MLC    M,MI
        MLC    N,NJ
BO      BWZ    BOO,COL&X2,K
        C      ZERO4,COL&X2
        BH     BP
BOO     MA     FOUR,X2
        MA     FOURM,X3
        S      ONE,NJ
        C      NJ,ZERO4
        BL     BO
        BE     ENDINS
BP      MLC    X1,X3
        MLC    W,X2
        MLC    N,NJ
BQ      BWZ    BQQ,ROW&X1,K
        B      BT
BQQ     MLC    ZERO4,ROW&X1
```

```
BR      S       AYTT,COST&X3
        C       ZERO4,COST&X3
        BE      BS
        A       AYTTO,COST&X3
        S       ONE,COST&X3
BS      MA      FOUR,X2
        MA      FOURM,X3
        S       ONE,NJ
        C       NJ,ZERO4
        BL      BR
        MA      FOUR,X1
        MLC     X1,X3
        MLC     W,X2
        MLC     N,NJ
        B       BV
BT      MA      FOUR,X1
        MA      FOUR,X3
BV      S       ONE,MI
        C       MI,ZERO4
        BL      BQ
        MLC     W,X1
        MLC     W,X2
        MLC     W,X3
        MLC     M,MI
BW      BWZ     BZ,COL&X2,K
BX      S       NINT,COST&X3
        C       ZERO4,COST&X3
        BE      BY
        A       NINTO,COST&X3
        S       ONE,COST&X3
BY      MA      FOUR,X1
        MA      FOUR,X3
        S       ONE,MI
        C       MI,ZERO4
        BL      BX
        MLC     W,X1
        MLC     M,MI
        MA      FOUR,X2
        B       BZZ
BZ      MA      FOUR,X2
        MA      FOURM,X3
BZZ     S       ONE,NJ
        C       NJ,ZERO4
        BL      BW
        B       AE
CA      MLC     K,MIN
        MLC     W,X1
        MLC     W,X2
        MLC     W,X3
        MLC     M,MI
        MLC     N,NJ
CB      BWZ     CE,COL&X2,K
CC      BWZ     CD,ROW&X1,K
```

```
318          C       MIN,COST&X3
319          BH      CD
320          MLC     COST&X3,MIN
321    CD    MA      FOUR,X1
322          MA      FOUR,X3
323          S       ONE,MI
324          C       MI,ZERO4
325          BL      CC
326          MLC     W,X1
327          MLC     M,MI
328          MA      FOUR,X2
329          B       CF
330    CE    MA      FOUR,X2
331          MA      FOURM,X3
332    CF    S       ONE,NJ
333          C       NJ,ZERO4
334          BL      CB
335          MLC     W,X1
336          MLC     W,X2
337          MLC     W,X3
338          MLC     M,MI
339          MLC     N,NJ
340    CG    BWZ     CH,ROW&X1,K
341          B       CJ
342    CH    A       MIN,COST&X3
343          MA      FOUR,X2
344          MA      FOURM,X3
345          S       ONE,NJ
346          C       NJ,ZERO4
347          BL      CH
348          MLC     W,X2
349          MLC     N,NJ
350          MA      FOUR,X1
351          MLC     X1,X3
352          B       CK
353    CJ    MA      FOUR,X1
354          MA      FOUR,X3
355    CK    S       ONE,MI
356          C       MI,ZERO4
357          BL      CG
358          MLC     W,X1
359          MLC     W,X2
360          MLC     W,X3
361          MLC     M,MI
362          MLC     N,NJ
363    DA    BWZ     DC,COL&X2,K
364    DB    S       MIN,COST&X3
365          MA      FOUR,X1
366          MA      FOUR,X3
367          S       ONE,MI
368          C       MI,ZERO4
369          BL      DB
370          MLC     W,X1
```

```
                MLC     M,MI
                MA      FOUR,X2
                B       DD
        DC      MA      FOUR,X2
                MA      FOURM,X3
        DD      S       ONE,NJ
                C       NJ,ZERO4
                BL      DA
                BE      AH
        ENDINS  CS      332
                CS      299
                CC      1
                MLC     @COST@,264
                W
                CC      J
                CS      299
                MLC     M,MI
                MLC     W,X1
                MLC     W,X3
        PCT     MLC     COST&X3,229
                MA      FOURM,X3
                MLC     COST&X3,239
                MA      FOURM,X3
                MLC     COST&X3,249
                MA      FOURM,X3
                MLC     COST&X3,259
                MA      FOURM,X3
                MLC     COST&X3,269
                MA      FOURM,X3
                MLC     COST&X3,279
                MA      FOURM,X3
                MLC     COST&X3,289
                MA      FOURM,X3
                MLC     COST&X3,299
                W
                BCV     OFL1
                B       PD
        OFL1    CC      1
        PD      MA      FOUR,X1
                MLC     X1,X3
                S       ONE,MI
                C       MI,ZERO4
                BL      PCT
                CC      L
                CS      332
                CS      299
                MLC     @SEND@,264
                W
                CC      J
                BCV     OFL2
                B       PSD
        OFL2    CC      1
        PSD     CS      299
```

```
          MLC     M,MI
          MLC     W,X1
          MLC     W,X3
PG        MLC     SEND&X3,229
          MA      FOURM,X3
          MLC     SEND&X3,239
          MA      FOURM,X3
          MLC     SEND&X3,249
          MA      FOURM,X3
          MLC     SEND&X3,259
          MA      FOURM,X3
          MLC     SEND&X3,269
          MA      FOURM,X3
          MLC     SEND&X3,279
          MA      FOURM,X3
          MLC     SEND&X3,289
          MA      FOURM,X3
          MLC     SEND&X3,299
          W
          BCV     OFL3
          B       PH
OFL3      CC      1
PH        MA      FOUR,X1
          MLC     X1,X3
          S       ONE,MI
          C       MI,ZERO4
          BL      PG
          CC      L
          CS      332
          CS      299
          MLC     @ROW@,268
          W
          CC      J
          BCV     OFL4
          B       PK
OFL4      CC      1
PK        CS      299
          MLC     W,X1
          MLC     ROW&X1,234
          MA      FOUR,X1
          MLC     ROW&X1,244
          MA      FOUR,X1
          MLC     ROW&X1,254
          MA      FOUR,X1
          MLC     ROW&X1,264
          MA      FOUR,X1
          MLC     ROW&X1,274
          MA      FOUR,X1
          MLC     ROW&X1,284
          MA      FOUR,X1
          MLC     ROW&X1,294
          W
          CC      L
```

```
                BCV     OFL5
                B       PL
        OFL5    CC      1
        PL      CS      332
                CS      299
                MLC     @COLUMN@,265
                W
                CC      J
                BCV     OFL6
                B       PCL
        OFL6    CC      1
        PCL     CS      299
                MLC     W,X2
                MLC     COL&X2,229
                MA      FOUR,X2
                MLC     COL&X2,239
                MA      FOUR,X2
                MLC     COL&X2,249
                MA      FOUR,X2
                MLC     COL&X2,259
                MA      FOUR,X2
                MLC     COL&X2,269
                MA      FOUR,X2
                MLC     COL&X2,279
                MA      FOUR,X2
                MLC     COL&X2,289
                MA      FOUR,X2
                MLC     COL&X2,299
                W
                BLC     STOP
                B       OBJECT
        STOP    H
                END     OBJECT
```